8.0

Potable Water Element

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8.0 Potable Water Element

The Florida Keys are in a unique situation with regard to the supply of potable water. With virtually no freshwater rivers, lakes or streams, and few freshwater lenses, residents have had to rely on man-made collection and distribution systems in order to survive. Until 1940, no centralized public water supply system existed; residents relied, as they had for more than a century, on the unpredictable source of rainwater collected from roofs into cisterns. Private wells supplemented this source, but could only be tapped in the few areas where freshwater lenses exist.

In 1937 the Florida Legislature, aware that cisterns and container water could not adequately support the development of the Keys, created the Florida Keys Aqueduct Commission (FKAC). The Commission was formed to develop potable water facilities for Monroe County. In 1940 the FKAC reached an agreement with the United States Navy to share in the cost of a water main from the mainland. Water was pumped from the Biscayne Aquifer, and an 18-inch main was constructed from well fields near Florida City along the entire length of the Keys to Key West. The Florida Keys Aqueduct Authority (FKAA) replaced the FKAC in 1970 and assumed responsibility for the aqueduct. In 1981 FKAA, with financial assistance from the Farmer's Home Administration, commenced construction of major improvements to the system.

8.1 Sources of Water

There are no significant sources of fresh surface water in the populated Florida Keys portions of Monroe County. Two sources of groundwater underlie Monroe County - the Floridan Aquifer System, and the Biscayne Aquifer. Table 8.1 illustrates the relative positions and productivities of these hydrogeologic units.

The Floridian Aquifer System (FAS) is a confined artesian aquifer. In the Keys, wells tapping the FAS will flow at land surface at rates ranging from 75 to 1,000 gallons per minute. Although available in significant quantities, Floridian water requires desalination treatment before it is suitable for either potable or irrigation use. Chloride concentrations in the FAS range from 1,600 to 20,000 milligrams per liter, with concentrations generally increasing to the south. The Ocean Reef Club is the only consumer currently using enough Floridian Aquifer water to require an individual SFWMD permit.

Table 8.1
Ground Water Systems in Monroe County

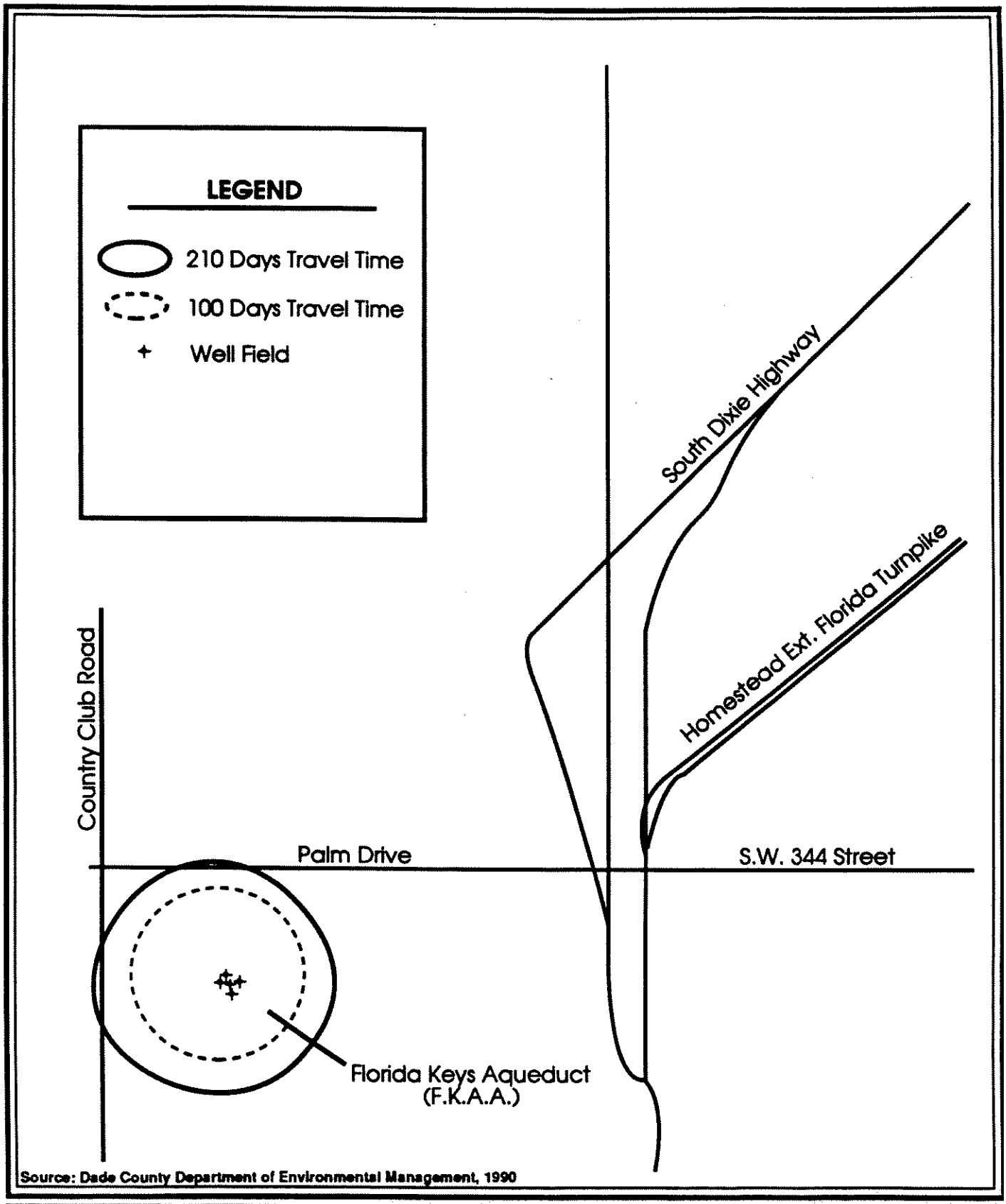
Hydrogeologic System	Hydro-geologic Unit	Water Resource Potential
Surficial Aquifer System	Biscayne Aquifer	Largely saline, a lense of relatively freshwater floats above the saltwater on some of the larger keys. Must be desalinated for potable use. No additional withdrawals will be permitted. Vulnerable to spills and contamination.
Intermediate Confining Unit	Hawthorn Confining Beds	Very low permeability, confining unit for the Floridian Aquifer System.
Floridan Aquifer System	Floridan Aquifer	Wells yield from 75 to 1,000 gallons of saline water per minute. Requires desalination for all uses. Some zones may be suitable for ASR applications.

Source: South Florida Water Management District, 1991

The Biscayne Aquifer is the largest supplier of freshwater in southeast Florida. In the Keys, water from the Biscayne Aquifer ranges from brackish to chloride levels associated with seawater, and requires desalination for potable use. On some of the larger keys, a lens of freshwater floats above the saltwater. The largest of these freshwater lenses occur on Key West and Big Pine Key, but limited quantities also occur on Cudjoe and Sugarloaf Keys. Chloride levels in these lenses are too high for human consumption, but are suitable for most irrigation purposes, and provide the major source of drinking water for wildlife. Some Monroe County residents provide their own water supply using home Reverse Osmosis (RO) plants to desalinate Biscayne Aquifer water, or collecting rain water in cisterns. However, due to the limited availability of fresh groundwater, its vulnerability to saltwater intrusion, and its importance to wildlife, no additional wells have been permitted in this shallow aquifer since February 1986. The primary source of water to the Keys is from the FKAA's Florida City wellfield, which pumps water from the Biscayne Aquifer in southeastern Dade County (see Figure 8.1).

Today, the FKAA remains the sole supplier of centralized potable water to the Florida Keys, and the vast majority of Monroe County residents receive their potable water from the FKAA system. There are alternative potable and non-potable water supplies in use in the Keys, however. Four other sources provide water supplies: private cisterns, private wells, home desalinization systems, and bottled water. Most users of these alternative sources rely on them only as supplements to the FKAA water. Cistern and well water, are often reserved for irrigation and other non-potable uses. A few residents of mainland Monroe County are served by private wells and cisterns.

In order to ensure the availability of an adequate quantity and quality of potable water, an intricate framework of federal, state and local regulations controls the process of supplying water to the Keys. After a brief discussion of regulatory system, existing facilities and planned improvements are



Source: Dade County Department of Environmental Management, 1990

KEITH and SCHNARS, P.A. ENGINEERS · PLANNERS · SURVEYORS	Monroe County Year 2010 Comprehensive Plan	FKAA Wellfield Location	Figure 8.1

described. A discussion of water conservation programs is included, followed by a discussion on the status of the FKAA system. Finally, a needs assessment and levels of service standards are presented.

8.2 Regulatory Framework

8.2.1 Federal Regulations

The federal Safe Drinking Water Act (Public Law 93-523) establishes operating standards and quality controls for the protection of public water supplies. As directed by this Act, the Environmental Protection Agency (EPA) has established minimum drinking water standards, to which every public water supply system must conform. Included are "primary" standards required for public health, and "secondary" standards which are recommended to attain a higher aesthetic quality of water.

8.2.2 State Regulations

In accordance with federal guidelines, the Florida Safe Drinking Water Act (Sections 403.850 - 403.864, F.S.) has been adopted, which designates the Florida Department of Environmental Regulation (DER) as the state agency responsible for the regulation of drinking water. The DER has therefore promulgated rules classifying and regulating public water systems, including mandatory water treatment criteria (Chapter 17-550. F.A.C.). The DER enforces both the primary and secondary water quality standards for public water supplies in Florida.

In addition to the direct regulation of water distributed in public water supply systems, DER establishes standards for various designated uses of natural waters, including potable water. Under DER's classification system Class 1 waters are designated for use as public potable water supplies. These waters are regulated under standards specifically designed to protect the public health. The DER also regulates the use of alternative water supply systems, such as RO plants.

The South Florida Water Management District (SFWMD) is responsible for managing water resources for a large region which extends from Kissimmee Valley to Key West and spans the territories of over eighty local governments. Through the consumptive use permitting process, SFWMD allocates water supplies among public utilities and other users to be distributed to consumers. The SFWMD can issue Consumptive Use Permits (CUPs) for a five or ten year period; the five year permits have become more commonplace, however. The CUPs authorize annual allocations, and can include a number of limiting conditions that address issues such as maximum daily withdrawals, water level monitoring, maintenance, and emergency procedures. An important addition to this permitting process is the water conservation requirement. As of 1988, SFWMD requires CUP applicants requesting 100,000 Gallons Per Day (GPD) or greater to submit a water conservation plan that meets SFWMD Guidelines. The FKAA has submitted this plan (October 1990) and it is currently under review by the SFWMD.

8.2.3 Local Regulations

The provision of potable water in unincorporated Monroe County is affected primarily by the regulations and policies of two governmental bodies, the FKAA and Monroe County, and peripherally by a third, Dade County. The FKAA, actually a state agency, serves as an autonomous corporate and political body whose primary function is to obtain, supply, and distribute an adequate water supply for

the Florida Keys. As the only centralized public water source, the FKAA requires, with a few exceptions to be described later, that all entities desiring a potable water supply must connect to the FKAA facilities if and when distribution lines are available. FKAA was created by Chapter 76-441, Laws of Florida and is subject to the provisions of Chapter 120, F.S. and the Florida Administrative Procedures Act.

The FKAA is governed by a Board of Directors, which appoints an Executive Director to manage the day-to-day operations and the field, administrative, technical and legal staff. FKAA's basic operating regulations are outlined in their Policy and Procedure Handbook, Chapter 48, which is distributed to all new FKAA customers. These policies cover the detailed organizational rules, provision of water service, service fees, engineering requirements, service area limitations, and alternative supplies.

Besides managing the centralized public water supply system, FKAA has "the authority to regulate all potable water supplies within its boundaries." (FKAA, 48-8.001(1)). The FKAA therefore has authority over the installation and operation of alternative water supplies. Single family and duplex residences using alternative systems, and water supply systems used solely for non-potable purposes are exempt from FKAA permitting requirements. However, any other entity wishing to construct or operate a well, cistern, RO system or other alternative supply system must comply with FKAA's conditions for approval (FKAA, 48-8.004).

Although the FKAA has primary responsibility for the potable water supply, the County has some jurisdiction over supply sources and distribution, especially with regard to land use and single family or duplex residential development. In compliance with FKAA regulations, the Monroe County Code requires "sufficient" potable water from an approved and permitted source. The Code recognizes alternative water sources, such as wells and cisterns, in addition to FKAA's distribution system. Section 9.5-305(c) of the Monroe County Code states that "individual wells shall only be permitted where there is no public supply of water feasible." Residents are allowed to continue the use of existing wells. Yet cisterns and other types of "independent water systems shall be encouraged whenever permitted" (Sec. 9.5-327(c)). A few residents of mainland Monroe County are served by private wells and cisterns.

The County has also implemented water conservation measures to augment SFWMD and FKAA programs. Sec. 9.5-327 of the County Code states potable water conservation standards. It requires all new development to install low volume plumbing fixtures with a maximum flush of 3.5 gallons for toilets, and a maximum flow rate of 3 gallons per minute at 60 pounds per square inch for showerheads and faucets.

8.3 Dade County Wellfield Protection Program

8.3.1 Wellfield Protection

The FKAA, Florida City Wellfield protection is accomplished through the provisions of the Dade County Potable Water Supply Well Protection Ordinance (Dade County Ordinance Section 24-12.1). The Wellfield Protection Ordinance contains the following provisions regarding the protection of Monroe County's water supply service:

8.3.2 Septic Tanks

The ordinance provides for regulation of septic tanks within the wellfield cone of influence as defined by Section 24-12.1 by requiring that the Dade County Department of Environmental Resources Management (DCDERM) find that the placement of septic tanks and septic tank drainfields are installed on a parcel of land as far away as is reasonably possible from potable water supply wells and by establishing specific septic tank sewage loading standards. In addition, the Ordinance requires that for septic tanks or septic tank drainfields located within the maximum day wellfield protection area, a minimum separation from the nearest public utility potable supply well equivalent to ten days travel time be provided. The specific distance of the ten-day travel time is dependent upon the transmissivity of the aquifer.

8.3.3 Sanitary Sewers

Section 24-12.1 establishes the following sewage loading restrictions and facilities construction requirements for all sanitary sewers installed within the wellfield protection area:

> Residential land use - No gravity sanitary sewer shall have an exfiltration rate greater than fifty (50) gallons per inch pipe diameter per mile per day. Sewer lateral lines located in the public right-of-way shall be a minimum of six (6) inches in diameter.
>
> Nonresidential land use - No gravity sanitary sewer shall have an exfiltration rate greater than twenty (20) gallons per inch pipe diameter per mile per day. Sewer lateral lines located in the public right-of-way shall be a minimum of six (6) inches in diameter.
>
> All sanitary sewer forced mains shall be constructed of either ductile iron or reinforced concrete pressure sewer pipe. No such ductile iron sanitary sewer force main shall exfiltrate at a rate greater than the allowable leakage rate specified in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch. No such reinforced concrete pressure sanitary sewer force main shall exfiltrate at a rate greater than one-half (1/2) the allowable leakage rate specified for ductible iron pipe in American Water Works Association Standard C600-82 at a test pressure of one hundred (100) pounds per square inch.
>
> Notwithstanding the provisions of (4)(b), all gravity sanitary sewers with invert elevations above the average surrounding water table elevation and all sanitary sewer force mains shall be tested to ensure compliance with the aforementioned exfiltration rate standards.
>
> A registered professional engineer shall provide written certification of the exfiltration rate for all manhole/gravity sewer pipe systems installed, in equivalent gallons per inch pipe diameter per mile of pipe per day (twenty-four [24] hours), and the exfiltration rate for all sanitary sewer force mains in gallons per hour per one thousand (1,000) feet of sanitary sewer force main installed. Existing gravity sanitary sewers with pipe diameters of eight (8) inches or more shall be visually inspected by television every five (5) years by the responsible utility or property owner to ensure both structural and pipe joint integrity.

Existing manholes shall be visually inspected for both structural and incoming pipe connection integrity every five (5) years.

Certified test and inspection results and repair logs shall be submitted to the department of environmental resources management within thirty (3) days after completion of the particular test, inspection, or repair.

8.3.4 Stormwater Disposal Methods

Stormwater disposal methods which are required by the Wellfield Protection Ordinance within the wellfield protection area are listed in Table 8.2.

Table 8.2
Allowable Storm Water Disposal Methods for Residential and Nonresidential Property

Travel Time in Days or Distance in Feet from Property to Nearest Public Utility Potable Water Supply Well	Allowable Methods for Storm Water Disposal
More than 30 days but not exceeding 210 days	Infiltration or seepage or overflow outfalls only
More than 10 days but not exceeding 30 days	Infiltration or seepage only
More than 100 days but not exceeding 10 days	Infiltration only
100 feet or less	None

Source: Dade County Wellfield Protection Ordinance, 1987

Liquid Waste Storage Disposal or Treatment Methods other than septic tanks utilized for the disposal discharge, storage or treatment of domestic sewage, sanitary sewer lift stations; and public sanitary sewers are subject to the following provisions:

Notwithstanding the grandfathering provisions of the wellfield protection ordinance, liquid waste storage, disposal or treatment methods (other than septic tanks utilized for the disposal discharge, storage or treatment of domestic sewage; sanitary sewer lift stations, and public sanitary sewers) are prohibited within the wellfield protection area.

8.3.5 Prohibition of Hazardous Materials Within Wellfield Protection Areas

Approval by the DCDERM is required for any non-residential use, excluding agricultural and rock mining uses, within the maximum day pumpage wellfield protection area. This approval is required of any land use which generates, handles, disposes of, discharges or stores hazardous materials. Approval is granted only if the DCDERM determines that all potential sources of pollution will be located as far away as is reasonably possible from all potable water supply wells; that hazardous materials will not be

used generated, handled, disposed of, discharged or stored on that portion of the property; and that the following water pollution prevention and abatement measures are addressed:

(a) monitoring and detection of water pollution caused by hazardous materials;

(b) secondary containment of water pollution caused by hazardous materials;

(c) inventory control and record keeping of hazardous materials;

(d) stormwater management of water pollution caused by hazardous materials; and

(e) protection and security of facilities utilized for the generation, storage, usage, handling, disposal or discharge of hazardous materials. [Section 24-12.1(4)(e)].

Replacement, modification or limited expansion of existing facilities which will substantially reduce the existing risk of pollution from hazardous materials are reviewed by the DCDERM based on the following criteria:

(a) whether the proposed replacement, modification or limited expansion of the facility will provide adequate and increased monitoring and detection of pollution which may be or which has been caused by the hazardous materials on the property;

(b) whether the proposed replacement, modification or limited expansion of the facility will provide adequate and increased secondary containment of pollution which may be or which has been caused by the hazardous materials on the property;

(c) whether the proposed replacement, modification or limited expansion will provide adequate and increased inventory control and record keeping of hazardous materials on the property;

(d) whether the proposed replacement, modification or limited expansion will provide adequate and increased stormwater management of pollution which may be or which has been caused by the hazardous materials on the property; and

(e) whether the proposed replacement, modification or limited expansion will provide adequate and increased protection and security of the facilities utilized for the generation, storage, usage, handling, disposal or discharge of hazardous materials on the property. [Section 24-12.1(5)(c)].

8.3.6 Excavation

Excavation activities within the Wellfield Protection Areas require approval from the DCDERM and must comply with the following requirements:

(a) The property upon which the excavation has occurred or will occur and that portion of the property which has not been excavated or will not be excavated shall be provided with protection and security measures to prohibit the handling, disposal of, discharge storage of hazardous materials, solid waste, or liquid waste in the excavation area or on the property which has not been excavated or will not be excavated. Said protection and security shall be subject to the approval of the director or his designee.

Furthermore, the owner of the property upon which the excavation has occurred or will occur and that portion of the property which has not been excavated or will not be excavated in form(s) prescribed by the director and approved by the Board of County Commissioners. The covenants shall be recorded in the public records of Dade County, Florida, by the DCDERM at the expense of the owner of the property upon which the excavation is to occur, or

(b) The excavation has a valid excavation permit or equivalent municipal permit for excavation and a valid Class IV permit, if required by Article II of the Wellfield Protection Ordinance, which was obtained prior to September 30, 1983, which permits have been valid and continuously in full force and effect since their issuance. [Section 12-12.1(7)].

8.3.7 Pipelines for Hazardous Materials

Notwithstanding the grandfathering provisions of the Potable Water Supply Well Protection Ordinance, no installation, construction or operation of any pipeline or portion of pipeline used for the transmission or storage of any hazardous materials within the basic wellfield protection area is allowed. The grandfathering provisions provide that pipelines constructed prior to July 13, 1984, the effective date of the ordinance, are not subject to the ordinance and can remain operational.

8.3.8 Prohibition of Resource Recovery and Management Facilities within Wellfield Protection Areas

Notwithstanding the grandfathering provisions of the Potable Water Supply Well Protection Ordinance, no permits are issued for any resources recovery and management facility within the basic wellfield protection area of any public utility water supply well. The grandfathering provisions of the ordinance provide that valid permits for resource recovery facilities issued no later than March 12, 1987 may be renewed.

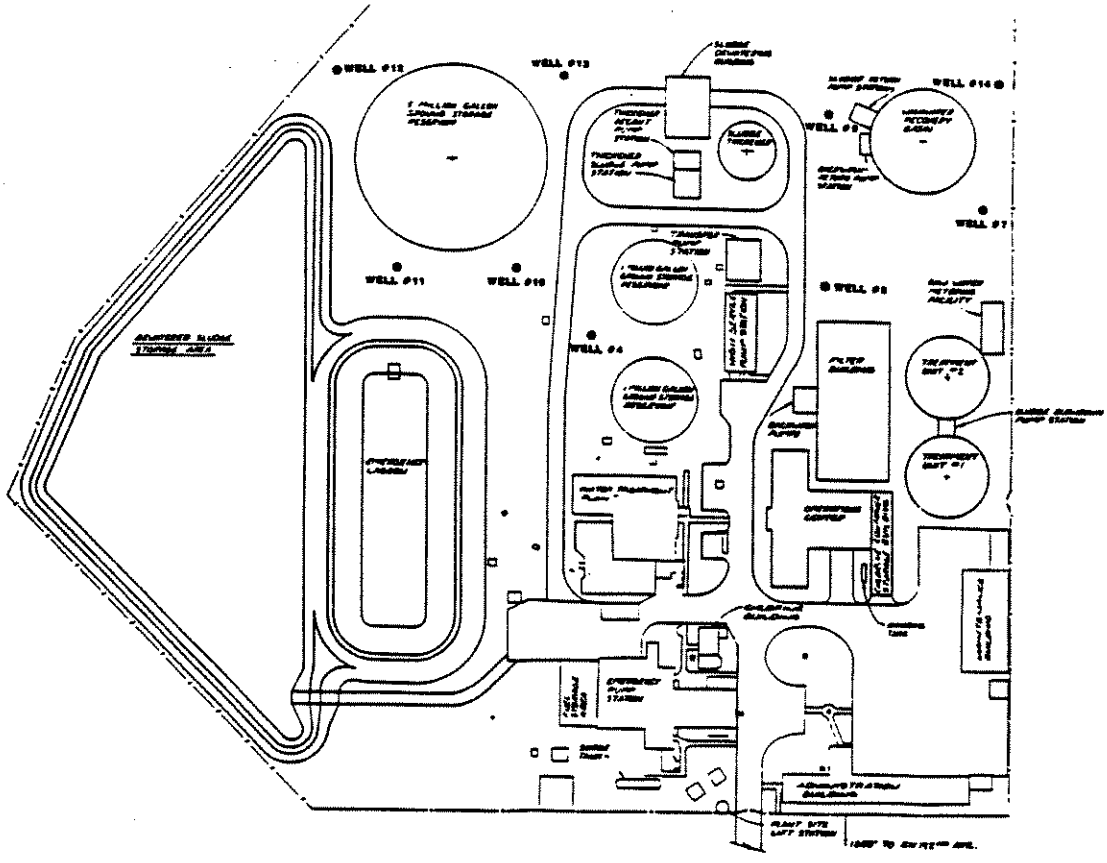
8.4 Potable Water Supply and Treatment Facilities

8.4.1 The Florida Keys Aqueduct Authority

The Florida Keys Aqueduct Authority (FKAA) is the sole supplier of potable water to Monroe County. The FKAA is an autonomous entity created by Chapter 76-441, Laws of Florida as amended. (The primary purpose of the FKAA is to obtain, supply, and distribute an adequate water supply for the Florida Keys). The service area of the FKAA includes all of the lands within Monroe County, but the Authority has the power to obtain potable water outside of its boundaries and transmit it for sale within its geographic boundaries, and also to serve customers residing within one mile of its existing pipeline from its wellfield at Florida City in Dade County. The FKAA has adopted a policy not to provide water connections or hookups for mainland Monroe County, National Wildlife Refuges and designated hardwood hammock areas. These lands are exempted in order to comply with the federal legislation. This is a result of federal agencies having jurisdiction over such areas and the requirements to enforce various provisions of federal law, including the Endangered Species Act of 1973, the Environmental Policy Act, and Executive Orders Numbers 11988 and 11990. More specifically, residents of mainland Monroe County must provide their own water supply and are exempt from the FKAA approval process. In addition, FKAA is prohibited from providing water hookups or connections to the Crocodile Lake National Wildlife Refuge, the Key Deer National Refuge, and the Schaus Swallowtail Butterfly Refuge. Also excluded from service because of wildlife species habitats are: all of No Name Key, portions of Big Torch Key, and portions of Big Pine Key north of Watson Boulevard. Hardwood hammock areas excluded comprise portions of Stock Island, small portions of Cudjoe Key (near a bald eagle nest) and Big Pine Key (cactus hammock), and all of several offshore islands. The Potable Water Map series in the Map Atlas shows all the areas in the Keys that are excluded from centralized potable water hookups.

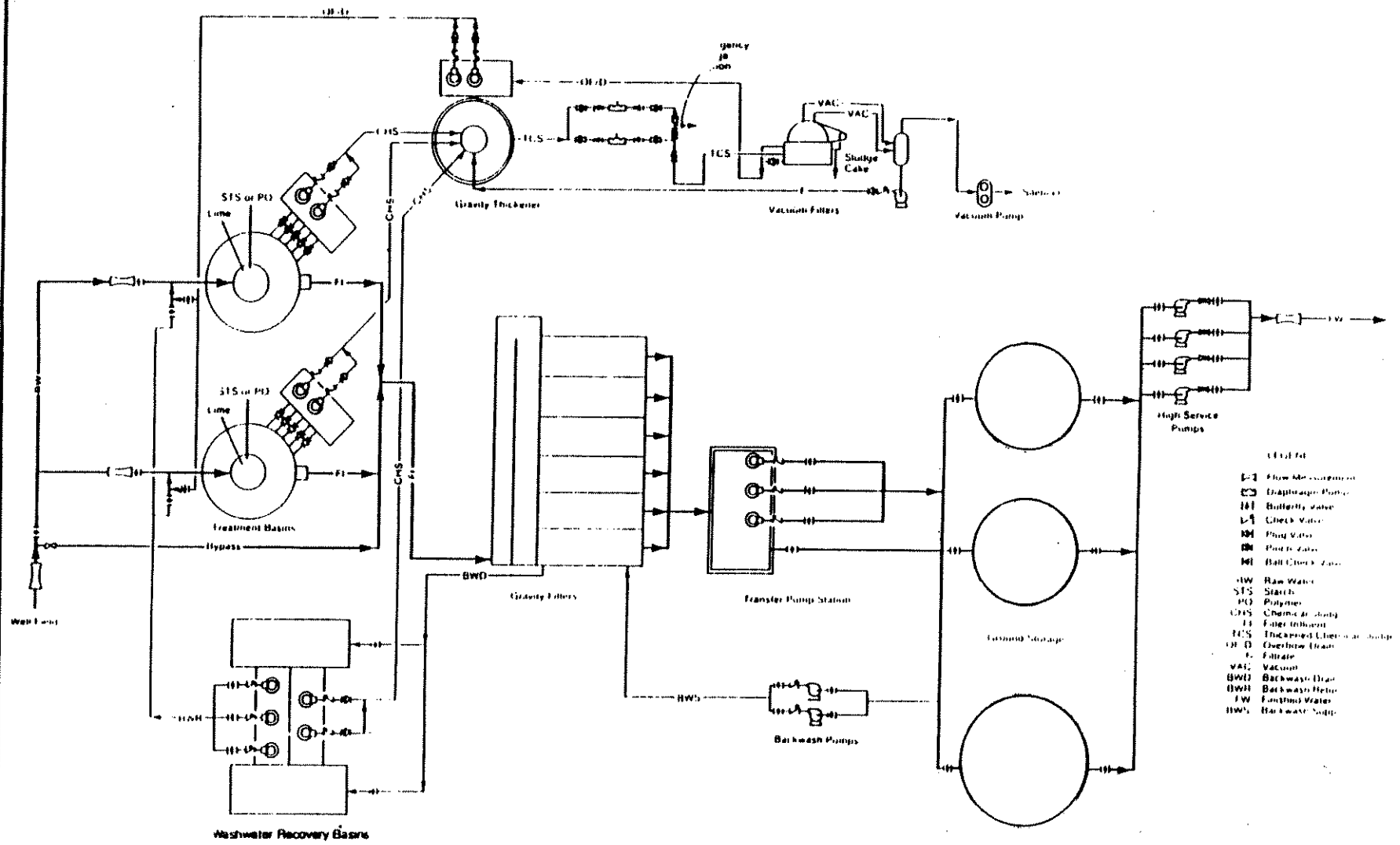
The FKAA's sole source of water for withdrawal is the Biscayne Aquifer. The South Florida Water Management District (SFWMD) regulates water withdrawal from the aquifer through the issuance of Consumptive Use Permits. The Consumptive Use Permit currently in effect (SFWMD Water Use Permit No. 13-00005-W) was issued on June 14, 1990 and is valid for a five year period ending June 14, 1995. This permit is actually a re-issuance of a permit granted by SFWMD on July 10, 1986 which was scheduled to expire on July 10, 1995 and permitted an annual withdrawal of 5.11 billion gallons per year, an average daily allocation of 14.0 million gallons per day and a maximum daily withdrawal of 19.3 million gallons per day. In 1989 raw water pumpage records indicate that the FKAA was operating at 98% of its permitted annual allocation and an application requesting a modification increasing the annual allocation by .91 billion gallons per year through the Year 2000 was submitted. The permit issued by SFWMD in 1990 allows for an annual increase of .45 billion gallons for a total annual withdrawal of 5.56 billion gallons, an average daily allocation of 15.24 mgd, and a maximum daily withdrawal of 19.77 mgd including an allocation to the Navy of 2.4 mgd.

The following is a description of the FKAA's facilities and water production and distribution system excerpted from the Authority's December 1989 Application for Water Use Permit Modification. The FKAA system components are shown in Figure 8.2 and 8.3. The entire system consists of the wells, pumps and storage tanks at Florida City, which connects to the water treatment facility and then to main and distribution lines, pump stations, and various storage tanks along the chain of keys to Key West.



Source: Florida Keys Aqueduct Authority Master Plan: CH2M Hill,1985

KEITH and SCHNARS, P.A. ENGINEERS · PLANNERS · SURVEYORS	Monroe County Year 2010 Comprehensive Plan	FKAA Florida City Well Layout	Figure 8.2



Source: Florida Keys Aqueduct Authority Master Plan: CH2M Hill, 1985

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Monroe County Year 2010 Comprehensive Plan

FKAA Florida City Treatment Plant Schematic

Figure 8.3

8.4.2 Florida City Wellfield

The primary raw water source for the system is a wellfield withdrawing from the Biscayne Aquifer west of Florida City in southeast Dade County. The aquifer consists of highly permeable limestone and underlies most of Dade and Broward Counties. The aquifer, approximately 75 feet thick at the FKAA wellfield, is recharged directly by rainfall, the network of SFWMD canals, and ground water seepage. The aquifer discharges through evapotranspiration, drainage and seepage to the Florida and Biscayne Bays, and by wellfield pumping.

A condition of the permit requires FKAA to monitor and submit data from the Salt Water Intrusion Monitoring (SWIM) program to the district on a monthly basis. In accordance with an additional condition of the permit FKAA is implementing a Saline Water Intrusion Monitoring Program (SALT) that utilizes 6 monitoring wells to measure any movement of the saline water interface. The SFWMD criteria to prevent saltwater intrusion is that one-foot head of fresh water be maintained between the wellfield and the saline water source. Saltwater intrusion usually results from a sustained decrease in fresh water head, allowing saltwater to migrate inland. Results of groundwater modeling indicate that drawdowns associated with increased withdrawals are minimal. The FKAA in cooperation with the United States Geologic Survey (USGS) maintains a ground and surface water quality monitoring network around the wellfield that is sampled monthly.

The network consists of three wells with continuous water level recorders, three canal sampling points, and six monitor wells. From the data included in the 1989 Application for Water Use Permit Modification it was concluded that in 1989 the 1000 mg/L isochlor was estimated to be 4 to 5 miles southeast of the wellfield and was in approximately the same location as was reported in 1974.

8.4.3 Water Treatment and Storage Facilities

The Florida City Water Treatment Plant (FCWTP) underwent extensive modification completed in August 1989 and is the sole water treatment facility utilized by the FKAA. The Florida Department of Environmental Regulation rated capacity for the FCWTP is 22 mgd. The FCWTP uses a process of lime softening followed by filtration as the core of its treatment process. Water disinfection is accomplished through contact with free or combined chlorine. Fluoridation is also provided to reduce the incidence of dental cavities.

The raw water flow rate is measured at each well discharge line by electronic, propeller type flow meters. A raw water metering facility measures total flow into the treatment system. Following treatment, the total treated water leaving the pipeline is also measured with a flow meter. Next, the total treated water pumped to the transmission main is measured and finally meters measure the flow at end user locations.

The raw water quality in the Biscayne Aquifer continues to be acceptable for potable water supply. With treatment, this water is capable of meeting all federal and state primary and secondary water quality standards. In addition to governmental quality standards, potable water should be appealing to the public: clear, colorless, pleasant to the taste, cool, non-staining, and convenient to use. The raw water supply at Florida City is also capable of satisfying all these criteria with minimal treatment. The total hardness of the raw water does pose treatment problems, however. The raw water hardness at

Florida City, 300 MG/L as CaCO, exceeds what is normally considered the desirable range for domestic consumption. The American Waterworks Association suggests a finished water hardness goal of 100 MG/L as CaCo for distribution. The Florida City Treatment Plant currently produces finished water with a total hardness between 100 MG/L and 120 MG/L as CaCO.

Storage facilities maintained by the FKAA have a total storage capacity of 39.5 MG; of this amount, there is 7 MG of storage available in above ground storage reservoirs at Florida City, consisting of two 1MG and one 5MG reservoirs. The remaining capacity is obtained from tanks located throughout the transmission and distribution system that provide an additional 9.5 MG of storage capacity.

The FKAA is a closed system that does not have any interconnects with other water supply systems. Emergency pumping stations are located at Florida City (9.0 mgd), Ramrod Key (12 mgd) and Stock Island (5 mgd). The FKAA is currently implementing an Aquifer Storage and Recovery (ASR) system in the Keys. The ASR concept involves storage of treated water in a suitable zone within the aquifer such that it can be recovered when needed. The purpose of the program is to create storage for treated water to provide potable water service to customers in the event of an emergency involving interruption of the production and/or distribution systems. At the present time the ASR program is in its third phase and actual fresh water pumping into underground areas confined by impermeable clay layers is taking place in Marathon. Stock Island is expected to be the next test area. The ultimate goal of the ASR program is to store 50 million gallons underground of the desired 90 million gallon emergency water supply. The 90 million gallons would supply FKAA users for a 10 day period at 1/2 the average daily use. The ASR program is discussed further under the FKAA capital improvement plan.

8.4.4 Reverse Osmosis Water Treatment Facility

The FKAA has a reverse osmosis desalinization plant located at Stock Island. The treatment plant has a capacity of 2.7 MGD and is maintained on a standby condition. The plant can be made operational within 48 hours. The plant was originally constructed to provide additional treated water while the 18" transmission system was being upgraded in 1983. The plant was constructed before economical membrane technology was developed; thus, high production and maintenance costs preclude its everyday use.

8.4.5 Water Transmission and Distribution

The FKAA distributes potable water from the treatment plant to the Keys via a 130-mile, large-diameter main running the length of U.S. Highway #1 that is connected to a series of storage and pumping facilities (see Figures 8.4 and 8.5). Recent water main installations have been buried as a means of hazard mitigation. A separate network of small distribution lines on each Key connect to the transmission main.

The transmission facilities consist of approximately 37 miles of 36-inch diameter pipe from Florida City to Tavernier, 43 miles of 30-inch diameter pipe from Tavernier to Marathon, 24-inch diameter pipe from the east end of the Seven Mile Bridge to Upper Sugarloaf, and 18-inch diameter main from Upper Sugarloaf to Key West. Portions of this 18-inch main were part of the original transmission line installed in the 1940s. The older 18-inch main also remains in service parallel to and interconnected with the new transmission mains on the islands between Key Largo and Marathon. The extension of the 18-inch diameter pipe from Sugarloaf to Stock Island is anticipated to be upgraded to a 24-inch

diameter pipe by 1995. The 18-inch main used from Upper Sugarloaf to Stock Island does not have adequate capacity for sustained peak consumption for buildout of these areas (FKAA, 1990). Expansions will be further discussed in Section 8.6.3.

The transmission main serves approximately 430 miles of distribution lines in the Keys via separate distribution storage tanks and pump stations, and direct taps on the main. The distribution lines range in size from 3/4-inch to 12-inch in diameter. A 12-inch line connects Ocean Reef to the 36-inch main at US 1, for example. The majority of distribution lines, however, are approximately 2 inches in diameter.

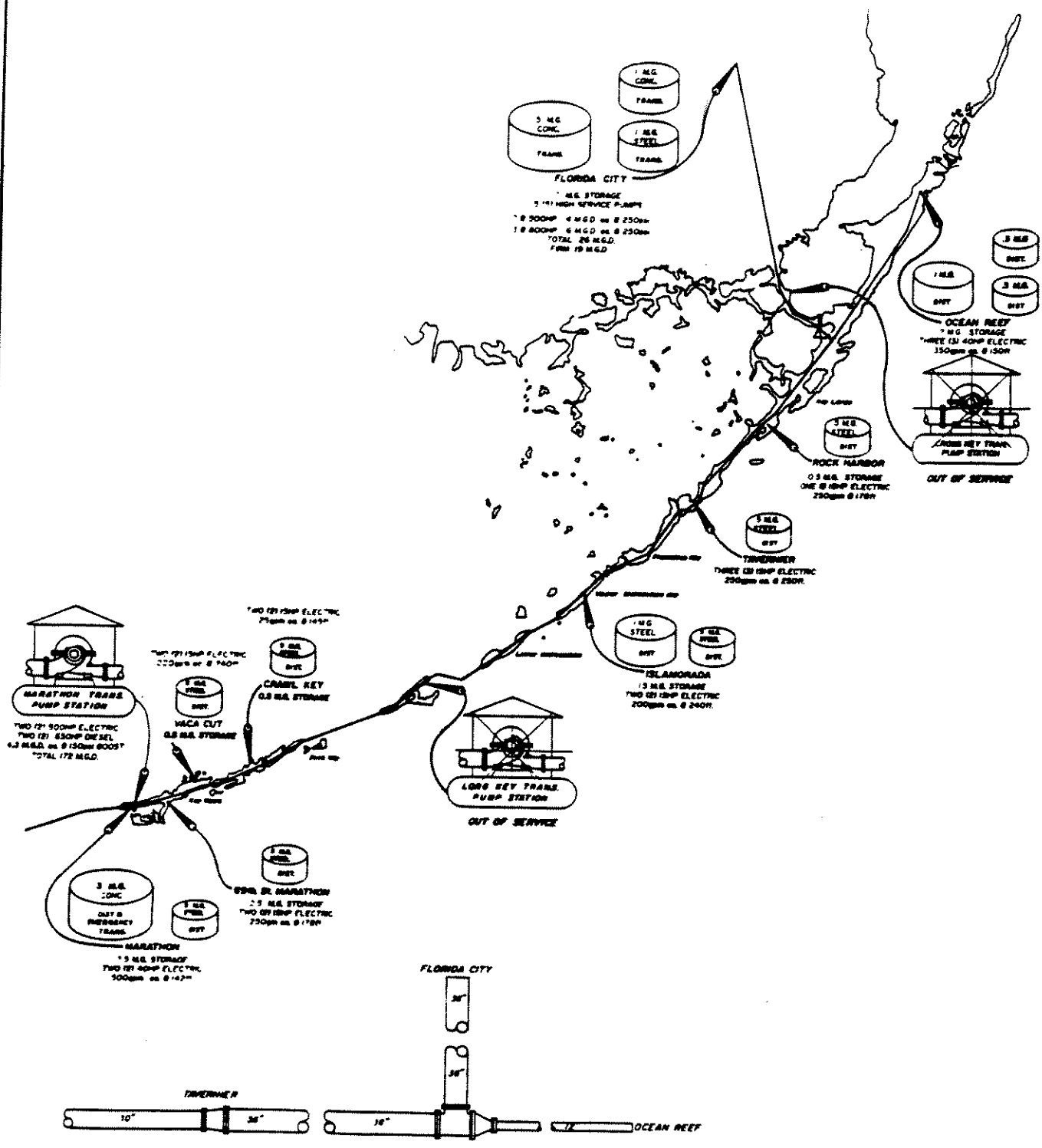
In-line booster pumping stations are used as necessary to increase and sustain an operating pressure of 250 PSI in the transmission main. Stations are located at Marathon and Ramrod Key with capacities of 17.2 (MGD) and 12 MGD, respectively. An additional station is located on Long Key, but has not been used since completion of the new transmission system.

8.5 FKAA System Status

8.5.1 Impact of FKAA Florida City Wellfield on Adjacent Users

FKAA has evaluated the impacts of its Florida City Wellfield on adjacent users of the Biscayne Aquifer. Regional groundwater flows at the site are towards the southeast. The aquifer's ability to yield water in this area is extremely high and it has been ranked as one of the most permeable in the world (Klien and Hull, 1978: USGS WRI 78-107). Pumping tests conducted by FKAA at the site in 1987, as part of a well replacement program, supports the Klein and Hull analysis.

To project the impacts from the proposed allocation on adjacent users, FKAA staff simulated the projected drawdown cone. The intent of the model parameters was to approximate worst case conditions, 90 days of maximum pumpage with no recharge from rainfall or canals. FKAA concluded that the potential for adverse impacts on adjacent legal users as a result of the approved allocation of 15.24 MGD is minimal. The existing legal users were identified by FKAA and were addressed in the predicted drawdowns. Simulations indicated that the drawdowns resulting from the requested withdrawals in the initial application would be less than 0.30 feet for average daily withdrawal of 16.5 MGD and .42 feet during maximum daily withdrawal at the Everglades Labor Camp Wellfield. The other large user, located outside the 1 mile radius, is the City of Florida City Wellfield, located 1.5 miles northeast of the FKAA wellfield. The simulated drawdown from all withdrawals in the immediate vicinity indicates that the cones of influence from the FKAA and the Florida Citywellfields join and share a common drawdown of 0.61 feet at the Florida City Wellfield during maximum withdrawal of 21.4 MGD for FKAA, 3.55 MGD for Florida City and .72 MGD for the Everglades Labor Camp Wellfield. The City of Homestead's wellfield is beyond the 0.34 feet drawdown contour. The predicted drawdowns are under the worst case scenario and do not take into account the maintained Canal levels of L-31W and Canal C-111. FKAA therefore concludes that the potential for adverse environmental impacts or impacts on existing legal users as a result of their proposed allocation



Source: Florida Keys Aqueduct Authority, 1988

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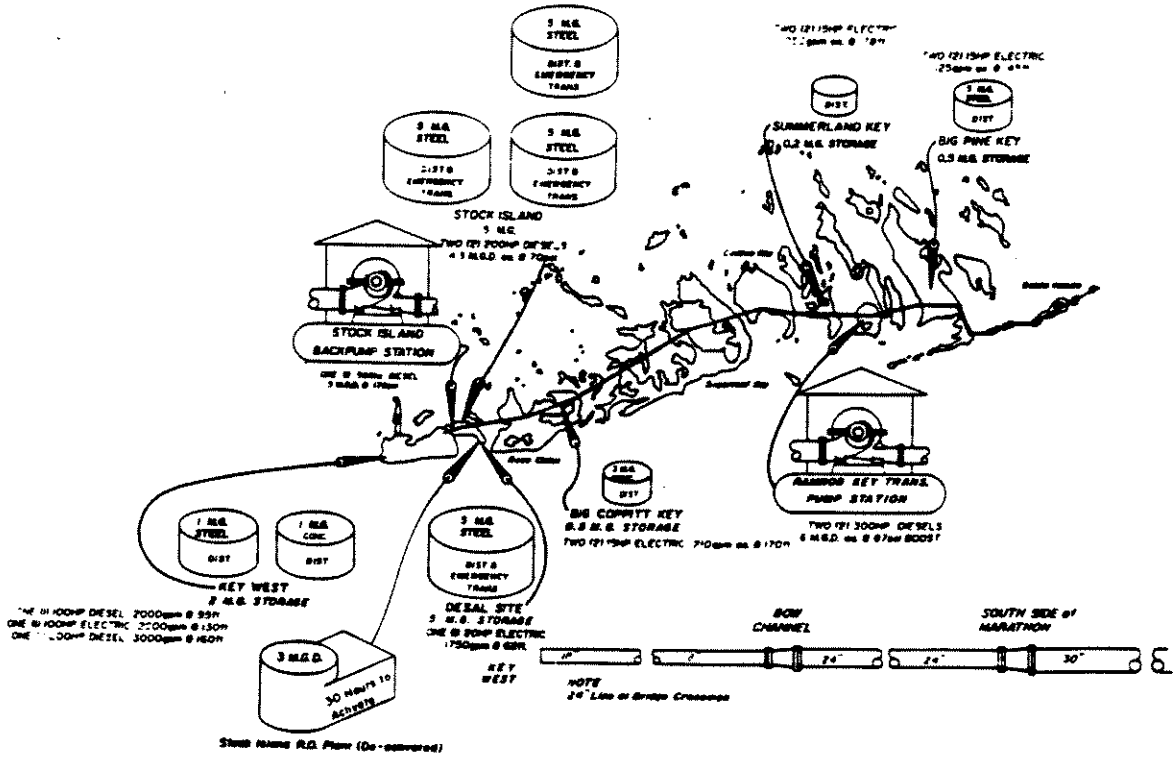
FKAA Water Supply System-Middle and Upper Keys

Figure 8.4



Source: Florida Keys Aqueduct Authority, 1988

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FKAA Water Supply System-Lower Keys

Figure 8.5

is minimal. Additionally, FKAA notes that the water levels in monitoring well G-864 (located to the southwest of the FKAA wellfield) average greater than 2.5 feet above sea level (please refer to Figure 8.6).

8.6 Water Quality

8.6.1 Salt Water Intrusion

The FCWTP is vulnerable to contamination from the ground surface of the Biscayne Aquifer. Problems include: the lack of a confining layer, localized direct recharge, proximity to saltwater, and the plant's limited area. The plant includes flexibility to accommodate unforeseen changes in raw water quality including backwash water recovery and recycling facilities.

FKAA has developed a monitoring network to measure the change in water levels and chlorides in the vicinity of the wellfield. (See Figure 8.6, FKAA Florida City Monitoring Network, for the locations of each of these monitoring stations.) The water levels varied from 1.0 ft. to 7.9 ft. National Geodetic Vertical Datum (NGVD), averaging 2.0 to 2.5 ft. NGVD. Monitor wells G-3166, G-1251, G-1256, and Canal C-110 exhibit raised chloride values; however, these three wells and the C-110 canal are south and east of the 1000 MG/L isochlor. (This isochlor delineates the saline water front.) Preliminary SFWMD data from the Saltwater Mapping Program (December 1989) that is being implemented in Dade County, indicates the saline interface is located in the production zones over two miles to the south and southeast of the FKAA wellfield. An updated saltwater monitoring program is required under Limiting Condition 26 of the 1990 CUP issued to FKAA. Current results of the monitoring program do not indicate any significant westward or northern movement of the 1000 MG/L isochlor which is used to delineate the saline water front of the region.

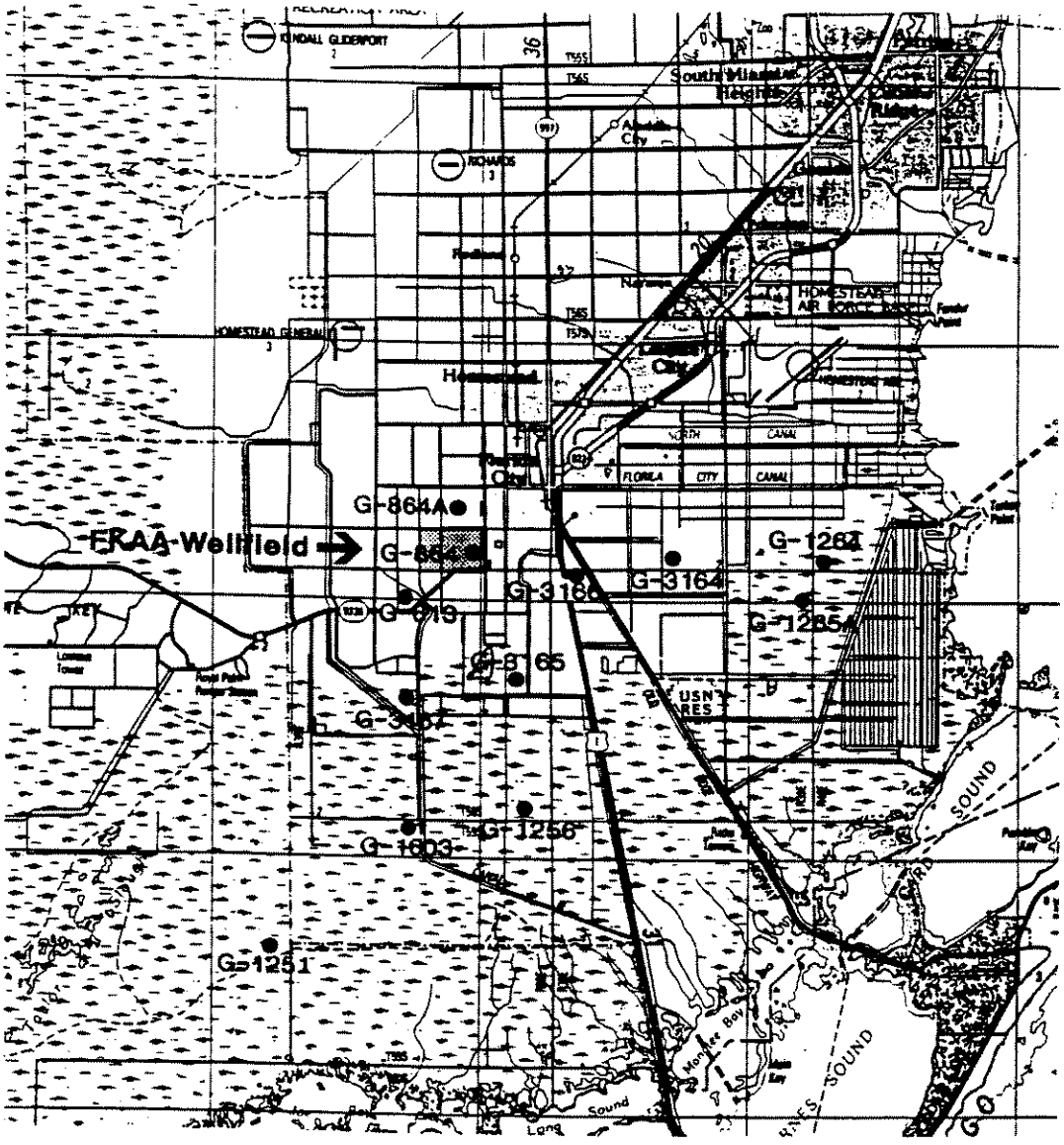
8.6.2 Wellfield Conditions

The capacity of the FKAA's Florida City wellfield was evaluated in a report prepared by F.W. Meyer of the U.S. Geological Survey in 1974. In this report water levels in southern Dade County, the potentiometric surface of the aquifer, and chloride levels at USGS monitoring wells were evaluated. Current and planned surface water conveyance systems in the vicinity were also reviewed.

The potentiometric surface of the Biscayne Aquifer as measured during the 1974 study showed that, during the period 1960-1971, the average water table elevation at the FKAA wellfield was 3.75 feet above Mean Sea Level (MSL). The lowest yearly elevation was slightly below MSL and the average for highest year was slightly higher than 5 feet above MSL.

In 1984, the United States Geologic Survey (USGS) conducted another survey of the potentiometric surface of the Biscayne Aquifer. These surveys, one conducted immediately following the wet season (October 1984) and the other conducted following the dry season (May 1984), can be used to evaluate regional water levels within the Biscayne Aquifer. From the surveys, the wet season potentiometric surface at the wellfield was estimated at 3 feet above MSL and the dry season at 1.5 feet above MSL.

The regional potentiometric surface is affected by groundwater withdrawals, recharge from conveyance canals, rainfall, and evapotranspiration. The apparent small effect of increased withdrawals on the



Source: Florida Keys Aqueduct Authority,

KEITH and SCHNARS, P.A. ENGINEERS · PLANNERS · SURVEYORS	Monroe County Year 2010 Comprehensive Plan	FKAA Florida City Monitoring Network	Figure 8.6

aquifer can be attributed to an extremely high transmissivity and storage coefficient. Consultants to FKAA have asserted that the aquifer could sustain withdrawals of up to 18 MGD average daily flow (ADF) without significant effect on regional water levels.

Recent data from the USGS water level records indicates that the aquifer has sustained a mean surface elevation of approximately 2.5 feet above NGVD. This is cited as evidence of minimal effect of increased pumpage on the water table.

The FKAA wellfield could potentially be impacted by salt water intrusion and/or development in the surrounding area. Presently, the FKAA, in cooperation with the USGS and Dade County Environmental Resource Management maintains a ground and surface water monitoring network around the well field to provide sufficient warning in the event of serious salt water intrusion. Chlorides average approximately 45 mg/l or less at the surface water monitoring points.

8.7 Potable Water System Improvements

8.7.1 FKAA Capital Improvements Plan

The FKAA has a long range capital improvements plan which addresses both distribution systems and transmission and supply systems improvements through the year 2005. The program's projected expenditures total is $81,156,637, with $53,881,002 earmarked for distribution system improvements and $27,275,635 earmarked for transmission and supply system improvements. The capital improvements plan is to be funded by system development fees and the existing surcharge on water sales. The FKAA Capital Improvements Program is presented in Tables 8.3 and 8.4.

The FKAA assesses System Development Fees to new and existing customers who modify, add or construct facilities which impose a potential increased demand on the water system. This fee is charged in order to equitably adjust the fiscal burden of new pipeline and to expanded or improve appurtenant facilities between existing customers and new water users.

All system development fees are allocated to the direct and indirect cost of capitalimprovements made necessary by actual and expected increased demand on the water system. In addition, the FKAA is authorized to charge tapping fees, meter test fees, and investigation fees.

8.7.2 Fire Flows

The FKAA has not had sufficient water pressure to provide fire protection throughout the Keys. In most instances the water distribution systems connected to the transmission mains are 2" in size and will not support fire flows. According to FKAA the water distribution system is being constantly upgraded on a pay as you go basis. It is the intent of the system upgrade to install an adequate pipe size for fire flow capabilities of up to 2000 gpm in the following areas:

(a) Key West and Stock Island (current fire flow areas)
(b) Everywhere on US 1, except non-developable areas
(c) Ocean Reef
(d) Key Colony Beach

(e) Layton
(f) Marathon
(g) Duck Key
(h) Tavernier

The FKAA Capital Improvements Plan is intended to provide improvements to some of the larger water distribution systems throughout the Keys, including new interconnections between the transmission main and the distribution systems. The new distribution piping systems are designed to provide fire flows of 750 gpm to suburban residential areas, 1500 gpm to mobile home and recreational vehicle areas and 2000 gpm to commercial, industrial and to high density residential areas within the targeted fire flow areas listed above. FKAA has indicated that the goal for completing this upgrade program is ten years. Large developments and resorts constructed off of the highway or in remote areas will install on-site water storage tanks with fire suppression pumps. In all other areas, the FKAA system will not be considered even as a future primary fire abatement source. However, all line upgrades will be designed and constructed so as to provide approximately 250 gpm to extreme locations.

Table 8.3
FKAA Capital Improvement Plan Transmission & Supply System

				Expenditure Allocation Fiscal Year Ending September 30						
Project	Project No.	Est./Actual Design fees	Est./Actual Constr. Cost	1989	1990	1991	1992	1993-1995	1996 2005	Total Project Cost
New Water Treatment Plant: Additional Wells/5MG Tank/ Diesel Pump Station Renovation	1003-87	1,100,700	14,109,996	4,452,496	140,000					15,210,696
Administration Building Repair	3012-88	In-House	47,233	47,233						47,233
Marathon Surge Tank	1009-88	12,900	176,240	176,240						189,140
New Marathon Cust. Serv. Office	1010-88	20,000	306,248	100,000	226,248					326,248
Valve Vaults at Canal Crossings	1010-88	29,300	150,000	25,260	2,247	151,793				179,300
Long Key Pump Station Roof	3001-89		10,000	10,000						10,000
Administration Building Expansion	3002-89	7,000	452,936	91,000	368,936					459,936
Ramrod Diesel	1001-91	33,000	405,000		33,000	405,000				438,000
R.O. Aerator	1002-91	In-House	100,000			100,000				100,000
Aquifer Storage Recovery Phase II	1012-88	89,500	136,500	214,900						226,000
Phase III (Mar)		286,000	313,082		548,060	51,022				599,082
Phase IV (Mar)		275,000	525,000			800,000				800,000
SALT Monitor Wells	1000-91	20,000	80,000		20,000	80,000				100,000
ASR Phase 1&2 - Stock Island	1001-91	85,000	115,000			200,000				200,000
Future 5 MG Tank (or SI-ASR)			1,020,000						1,020,000	1,020,000
Long Key Pump Station Renovation		60,000	840,000					900,000		900,000
Cathodic Protection-Phases 3,4,5,6		30,000	1,470,000				100,000	400,000	1,000,000	1,500,000
24" Main-Sugarloaf to Stock Island	1005-92	In-House	4,970,000				3,800,000	1,170,000		4,970,000
Total		2,058,400	25,227,235	5,117,129	1,338,491	1,787,815	3,900,000	2,470,000	2,020,000	27,275,635

NOTE: Not all costs have been allocated to a fiscal year.
SOURCE: Florida Keys Aqueduct Authority, 1990

Table 8.4
FKAA Capital Improvement Plan Distribution System

				Expenditure Allocation Fiscal Year Ending September 30						
Project	Project No.	Estimated Design fees	Estimated Constr. Cost	1989	1990	1991	1992	1993-1995	1996 2005	Total Project Cost
Gulf Rest/Baypoint S/D	2041-90	In-House	401,243		401,243					401,243
Stillwright Pt., Riviera Village & Paradise Pt. S/Ds	2042-90	In-House	523,000		523,000					523,000
Twin Lakes, Palma Sola, & Tavernier Ocean Shores S/Ds	2043-90	In-House	338,112		338,112					338,112
Indian Waterways & Indian Harbor	2044-90	In-House	370,516		370,516					370,516
Sherrill Park	2049-90	In-House	102,000		102,000					102,000
Tropical Bay & Mates Beach S/Ds	2045-90	In-House	229,775		229,775					229,775
Marathon Improvements Phase I	2046-90	In-House	500,000		478,000	22,000				500,000
Marathon Improvements Phase II	2047-90	In-House	500,000		359,692	140,308				500,000
Marathon Improvements Phase III	2048-90	In-House	550,000		261,656	288,344				550,000
Marathon Improvements Phase IV	2050-90	In-House	410,000		67,631	342,369				410,000
Big Pine Key Upgrade-Phase II	2019-89	In-House	600,458	600,458						600,458
Long Key Estates (Layton) & Crains S/D, Grassy Key	2004-89	In-House	952,476	212,055	740,421					952,476
Distribution System Road Crossings	2006-89	In-House	93,338	40,000	53,338					93,338
Holiday Homesites	2003-89	In-House	396,090	396,090						396,090
Sunrise Point/Seaside S/D	2008-89	In-House	261,000	252,293	8,707					261,000
Big Coppitt Tank Replacement	2002-89	Des-Build	178,853	178,853						178,853
Indian Mounds	2021-89	In-House	400,623							400,623
Key West Improvements	2005-89	160,000	3,053,000	722,500	2,330,500					,053,000
41st and 28th St., Marathon	2030-89	In-House	118,558	118,558						118,558

Project	Project No.	Estimated Design fees	Estimated Constr. Cost	Expenditure Allocation Fiscal Year Ending September 30						
				1989	1990	1991	1992	1993-1995	1996 2005	Total Project Cost
Ocean Isle Estates	2018-89	In-House	160,129		160,129					160,129
Key Colony Beach	2025-89	In-House	164,874	60,000						164,874
Punta Brisa S/D	2016-89	In-House	166,957	166,957						166,957
FDOT Relocations			610,000		360,000	250,000				610,000
Distribution Upgrade Projects		In-House				4,700,000	4,700,000	14,100,000	19,300,000	42,800,000
Total				3,148,387	6,784,720	5,743,021	4,700,000	14,100,000	19,300,000	53,881,002

NOTE: Not all costs have been allocated to a fiscal year.

SOURCE: Florida Keys Aqueduct Authority, 1990.

8.7.3 Storage

The FKAA Master Plan for Water Supply, Treatment and Transmission Facilities proposes increased storage capacity, to a total goal of 90 MG in the year 2010. This will provide for reliable service for distribution during plant or power outages, supplying 10 days of storage at fifty percent of the annual average daily flow in the year 2010. The total storage requirements will be divided between transmission and distribution systems. Fifty percent of the total storage capacity will be accessible to the transmission system for pumping and backpumping during plant and pipeline outages. The remaining fifty percent will be within the distribution system.

8.7.4 Aquifer Storage Recovery

The FKAA is currently implementing an Aquifer Storage Recovery (ASR) system on Marathon and is testing for an ASR system on Stock Island. Aquifer Storage Recovery is the underground storage of treated drinking water that is injected and recovered through the same well or wells and requires no retreatment other than disinfection.

Water is stored in each ASR well during low demand months of the year prior to the hurricane season. After the hurricane season, some reduction in storage may be helpful in meeting peak transmission and distribution system demands while also improving the quality of recovered water through successive storage recovery cycles. Typically, all of the water volume is recovered, although several cycles of injection and recovery may be required to fully develop the storage zone. The original estimate for a fully developed ASR system for the FKAA service area is between 50 MG of storage.

Two phases of the feasibility study have been completed and reported in: "The Aquifer Storage Recovery Feasibility Investigation, Phase One: Preliminary Assessment," and "Phase Two: Evaluation of Potential Aquifer Storage/Recovery Zones." Phase One of the study investigated three items: hydrogeologic conditions in the Keys, the availability and quality of recharge water and the development of a recommended test program. Phase Two identified two geologic intervals as potential storage areas for ASR purposes. The intervals are a shallow zone from approximately 410 to 440 feet below land surface (BLS) and a deep zone from 600 to 929 feet BLS. Phase III, the "Recovery Test Program" includes the cycle testing for recovery rates and will ultimately bring the storage on-line if the system is successful. Marathon is currently in Phase III and Stock Island is currently in Phase II.

Results of testing at each zone suggested that the shallow zone appears to be more suitable for ASR storage. A pilot hole drilling to 550 feet BLS at the shallow well location indicated a potential storage interval of unconsolidated sand from approximately 410 to 440 feet BLS. It also indicated considerable confinement above and below the potential storage interval. The pumping test results indicated a total dissolved solids concentration of 36,000 MG/L and a transmissivity of 8,000 GPD/ft. CH_2M HILL recommends that FKAA proceed with full scale testing of the shallow well, with the goal of injecting and recovering approximately 2 to 5 million gallons of fresh water.

Should the ASR project prove feasible for full implementation, it will be an important source of secure water storage for FKAA and Monroe County.

8.8 Water Conservation Programs

The Water Resources Act of 1972 formally designated the conservation of water as a key policy of the state and mandated that state and regional water resource agencies take steps to prohibit wasteful and unreasonable uses of the state's water supply. For South Florida, the adoption of the act thrust the SFWMD into a lead role in water supply planning and regulation.

Water conservation is a high priority in SFWMD policy and DER rules, in keeping with the statutory mandate. A key concept in any attempt to match water supply and demand is to avoid wasting the available supply. Florida law provides that wasteful uses are not protected, which in effect mandates that conservation and demand management measures be taken to protect the available resource from waste or abuse.

In order to maximize the reasonable and beneficial uses of water, the SFWMD will develop and implement demand management criteria District-wide, and focus its implementation on areas of critical water concern of which all of Monroe County is proposed for inclusion. These areas of critical concern will be defined in the water supply plans, and special criteria for mandatory demand management in these areas will be established considering the following issues:

(a) economics of implementation;

(b) existing and projected demands by source classification (potable versus nonpotable); and

(c) availability of source(s) for a specific level of service.

Implementation of the demand management program will be both passive (public information) and active (retrofitting, permit requirements for irrigation efficiencies, model landscape codes, etc). Development of the critical areas rules will proceed simultaneously with this development of this document.

As part of its efforts to conserve freshwater resources in areas of high demand, the District will continue to analyze and support the development of alternative water sources such as desalinization, reverse osmosis and wastewater reuse. Also, as noted below, the SFWMD will continue to investigate and support other supply augmentation alternatives. The development of other supply sources, however, does not lessen the requirements for conservation and efficient water uses. As discussed below, inefficient or wasteful uses of water are not considered reasonable or beneficial, as required by law for all legal uses.

A related concept found in Florida's water use policy is the use of the lowest quality water available and appropriate for a specific use. This policy, for example, encourages the replacement of high quality ground water with treated wastewater for irrigation purposes if a feasible source is available. The effect of this policy is to optimize the utilization of available resources by requiring diversification of sources. The SFWMD is required by Chapter 17-40, F.A.C., to designate areas of critical water supply concern. These areas have or will experience water supply problems in the next 20 years. Re-use will be required in such areas in accordance with SFWMD criteria. During the past decade, the use of potable water for lawn and landscape irrigation has drawn extensive attention, and has been the focus of numerous conservation campaigns. These efforts have included water shortage awareness campaigns and xeriscape (low-irrigation landscaping) programs. These types of aggressive water

conservation/efficient uses campaigns are supported by the Potable Water policies in the Policy Document.

The SFWMD will continue to work closely with local governments to encourage programs to reduce demands, develop alternative supply sources, protect environmental resources and otherwise carry out the Potable Water policies contained in the Policy Document.

The SFWMD imposed as a limiting condition on the Consumptive Use Permit issued in June 1990, a requirement to develop a plan for water conservation within the FKAA service area within six months. SFWMD requires that the water conservation plan be developed in accordance with the South Florida Water Management District (SFWMD) guidelines. The FKAA submitted its Water Conservation Plan in October 1990. The plan is currently under review by the district and addresses the water conservation measures described in Sections 8.8.1 through 8.8.8.

8.8.1 Leak Detection

Leaks in the transmission/distribution system have historically contributed to tremendous losses in potable water; losses that have now been substantially reduced by an aggressive leak detection program. Water consumption is primarily monitored by a leak detection technician through meter reading comparisons between finished water, transmission line master taps and customer meters. A schedule has been set up and routine investigations are performed in each area of the County on a bi-weekly basis. Weekly reports are submitted to the FKAA Operations Department and filed for future reference. One person is assigned the responsibility of leak detection on a full-time basis, with assistance available from the Operations personnel. A detection device was utilized in 1983, during which time FKAA unaccounted for water (leaks) totalled 33% based on production vs. sales. The latest figures available for the first five month of 1991 indicate an average unaccounted for water figure of 12.8% signifying a dramatic reduction in water loss from leaks.

8.8.2 Conservation Rate Structure

To curb demand, FKAA promotes public awareness and has a conservation-oriented rate structure. Table 8.5 compares FKAA's rates to those of other water utilities under the jurisdiction of SFWMD. FKAA has the most conservation-oriented rate structure of any of the utilities shown. FKAA has by far the highest base water rate, and the highest base charge for connection. In fact the FKAA base water rate of $ 5.68 per 1000 gallons is over 3-1/2 times the rate of the second highest utility listed, that of Broad View Park Water Company. These high rates are effective deterrents of wasteful water use. In addition, FKAA charges a higher surcharge per 1000 gallons if a consumer uses over 12,000 gallons per month. This surcharge is lower than in some other localities represented here, but the cutoff point of 12,000 for the higher surcharge is lower than many other utilities enforce.

8.8.3 Public Information Program

In 1988 the FKAA began a program to provide a Water Conservation Kit to each new customer and to existing customers on a request basis. The kit included a shower flow restrictor, a toilet tank water bag, and leak detector dye tablets. The Authority also sends an informational pamphlet to customers exceeding 20% of normal monthly consumption, which contains information related to finding and repairing plumbing leaks. The Authority conducts lectures at primary and secondary schools throughout the County and distributes informational pamphlets and water conservation activity books.

8.8.4 Xeriscape Landscape Ordinance/Permanent Irrigation Ordinance

Monroe County does not presently have a xeriscape landscape ordinance or a permanent irrigation ordinance, but will develop such regulations with input from the FKAA, SFWMD, and other appropriate agencies. Section 9.5-364 of the current Monroe County Land Development Regulations require that 70% of the plant materials used to satisfy landscaping requirements for new development will be native species which require little irrigation.

Xeriscape is simply a rally word for water efficient landscaping. It involves the utilization of plants which require little water or grouping plants according to their water needs thus irrigating more efficiently.

The following conclusions have been drawn following review of the above noted SFWMD Model Code. The costs associated with adopting an acceptable Xeriscape Landscape Ordinance would be negliable to the FKAA because the cost associated with development and enforcement would be the responsibilities of the municipalities. The costs to the homeowner would primarily be those associated with the "Minimum Tree and Shrub Planting or Preservation Requirements" outlined under Section 7 of the District's Model Code. However, those expenses should be offset by current base rate of water charged by the FKAA over an approximate 5 year period. A better idea of the potential water savings and projected costs associated with the adoption of such an ordinance will be developed and forwarded to the SFWMD as the FKAA and the Monroe County Growth Management District evaluate and develop the proposed landscape ordinance.

The projected costs to implement a program limiting landscape irrigation hours will primarily be the preliminary costs associated with notifying the public of the impending restrictions via newspaper advertisements, radio spots and envelope stuffers. The potential savings will be minimal, assuming that the restrictions on hours will not deter any individuals from completely foregoing landscape irrigation. Water savings will basically be in direct relation to the amounts of water lost due to evaporation when landscape irrigation is performed during the midday hours.

A water efficient irrigation system can be achieved through an irrigation system audit and calibration program. Of the 35,000 accounts within the FKAA service area approximately 600 have some form of landscape irrigation system, of which approximately 100 are not supplied by the FKAA's potable water system. Irrigation system auditing would include testing of the water source for pressure and output rate, testing sprinkler heads for precipitation rate and coefficient of uniformity and setting irrigation zones for proper times and frequencies. Using the SFWMD Blaney Criddle model as the ideal irrigation requirement, a 5000 sq. ft. lot would take a technician approximately 2 hours to complete an audit. Based on a study conducted in Hillsborough County, Florida which documented water savings resulting from a calibrated and properly scheduled irrigation system, an average of 27% water savings would result at each participating home. 100% participation can be expected using FKAA personnel to perform the work. Assuming that outdoor water use is approximately 25% of the consumer total use, potential water savings per home would be approximately 4000 gallons per year.

Table 8.5
Water Usage Rate Comparison

Utility Company	Base Charge 3/4-5/8" Meter	1" Meter	Base Water Rate $/1000 Gal	Surcharge $/1000 Gal
FKAA 9/88	11.36	28.40	5.68	0.10 to 12,000 0.50 over 12,000
City of Boca Raton	9.48	9.48	0.35 0.85 1.10	<25,000 25-50,000 >50,000
Broad View Park Water Company	5.73	14.33	1.56	
City of Coral Springs	8.95	8.95	0.75 0.98	<11,000 >11,000
Homestead (city)	3.50		0.49	
Opa-Locka (city)	4.50		0.72	
City of Pompano Beach	6.10		0.75 1.04	<10,000 >10,000
Miami-Dade Water and Sewer Authority	4.2		0.9332	

Source: BRW, Inc., 1990 as presented in the FKAA Water Conservation Plan 1990.

8.8.5 Plumbing Fixture Efficiency Standards

In conjunction with implementation of Potable Water Element Policy 801.8.1, the FKAA expects that plumbing fixture standards will be addressed within the County's building codes and will require the installation of ultra-low volume fixtures for all new construction. The projected average monthly water consumption reduction per residential unit will be approximately 1,500 gallons per month.

8.8.6 Filter Backwash Recycling

Recycling of the sludge decant from the sludge thickeners is performed continually at the Florida City Water Treatment Plant.

8.8.7 Reuse of Wastewater

No relationship currently exists between the FKAA and wastewater treatment facilities operating in unincorporated Monroe County. Wastewater reclamation in Monroe County could play a substantial role in the water supply inventory. There are 277 existing wastewater treatment facilities in Monroe County of which one has a FDER rated capacity of 0.50 mgd or greater. This facility has a rated

capacity of 7.20 mgd and utilizes a surface water discharge for effluent disposal. Surface water discharge disposal results in a net loss/transfer from the water supply inventory. The facility could potentially make reclaimed water available for public access reuse. Utilization would require the addition of filtration and the associated chemical feed facilities, disinfection and reclaimed water monitoring equipment. The Sombrero Country Club in Marathon utilizes wastewater for golf course irrigation by collecting treated wastewater from a number of package treatment plants in the area and storing the water for irrigation use. Other commercial facilities reuse their own wastewater for irrigation purposes, most notably, Caloosa Cove on Lower Matecumbe Key, Holiday Inn on Key Largo and Breezy Palms on Upper Matecumbe Key.

8.8.8 Metering

The FKAA has the capability to meter raw water withdrawal and finished water introduction into the transmission lines at the Florida City Water Treatment Plant. Point of delivery metering is accomplished at every consumer within the FKAA system. This allows for accurate unaccounted for water reports to be produced on a monthly basis.

8.9 Proposed Level of Service (LOS) Standards

8.9.1 Water Quality Level of Service

Potable water quality can be expressed in terms of the water quality standards as defined in Chapter 17-55 Florida Administrative Code, "Public Drinking Water Systems". This legislation provides detailed criteria for Primary and Secondary drinking water standards. This legislation was promulgated in order to assure that public drinking water systems meet minimum drinking water requirements.

However, the United States Environmental Protection Agency (EPA) is expected to enforce recently adopted federal drinking water standards under the 1986 Safe Drinking Water Act. These standards, when in effect, will supersede all other drinking water standards.

The water quality level of service standards for Monroe County are as follows:

Minimum potable water quality shall be as defined by the U.S. Environmental Protection Agency.

The FKAA's construction of new treatment facilities has achieved the following planned objectives:

(a) Produce a finished water that meets all primary and secondary water standards including trihalomethanes.

(b) Provide full treatment including softening and filtration.

(c) Produce a stable non-corrosive water for distribution.

(d) Limit finished water hardness to between 100 MG/L and 150 MG/L as CaCO3.

8.9.2 Water Quantity Level of Service

The potable water quantity level of service methodology was developed in conjunction with South Florida Water Management District and the FKAA, from which the data was obtained.

The potable water LOS is divided into two categories: residential in gallons/capita/day, and nonresidential, expressed in gallons/square feet/day. Residential use is defined as permanent and seasonal residences including single family, multifamily, senior, and mobile homes. Nonresidential is defined as commercial use with hotels and motels included in this category and the Navy and governmental uses excluded due to their uniqueness and their projected constant consumption rates.

The raw data that is available from FKAA is broken down into the above uses for the entire County and for the Key West distribution system, which includes all of Stock Island and Key Haven, for water sold (water accounted for) for the past five years. FKAA also provided historic data on water produced.

The residential level of service is based on the permanent population plus the portion of the seasonal population living in residences. The seasonal number is defined as the average daily seasonal population living in residences on a annual basis.

The nonresidential level of service is based upon building square footages of commercial space in the unincorporated County including hotels and motels.

Development of the potable water level of service is based on a five year average (1986-1990) of the actual water consumption derived from the water sold figures provided by the FKAA. These figures are presented in Table 8.6. Key West (Table 8.7), governmental uses and the Navy usages are then excluded resulting in a pinpointing of the residential and non-residential potable water consumption figures for unincorporated Monroe County (Table 8.8). The figures are then prorated on raw usage (Table 8.9) to account for water lost. These figures are then compared to the population figures and building square footages for the five year period to determine per capita residential (Table 8.10) and square foot non-residential (Table 8.11) consumption rates. The proposed potable water level of service is based on a five year average of residential and non-residential water consumption and is presented in Table 8.12.

Although the Level of Service is based on data that excludes Key West, it is unnecessary to seek a separate allocation of FKAA's water supply exclusively for the unincorporated County. Only the Navy receives a separate allocation, a guaranteed 2.4 mgd, under FKAA's current CUP. This is because originally the water supply facilities for the Keys were installed, maintained and owned by the military. FKAA maintains the position that it can meet the needs of all its users throughout the County, and that it is under a state mandate to do so. Chapter 76-441, Laws of Florida, directs the Authority to "obtain, supply, and distribute an adequate water supply to the Florida Keys.". The regulatory system already in place, including the Consumptive Use Permitting process, the SFWMD & FKAA water conservation plans, the SFWMD water use restrictions, as well as FKAA's continual storage and distribution system upgrades all serve to ensure that FKAA is able to meet the water needs of its customers throughout the Keys. Furthermore, as FKAA's distribution and flow meters are set up now, it is not possible to monitor water use for only the City of Key West. All of Stock Island and Key Haven are on the same distribution system as Key West. For these reasons it is impractical and unnecessary to seek an interlocal agreement with FKAA for an allocation specifically for the unincorporated County.

Table 8.6
Water Sold - Entire Monroe County in Gallons (000's)

Year	Residential	Non-Residential			Total	Total	Percentages of Total	
		Government	Commercial	Navy	Non-Res	Res + Non-Res	Res	Non-Res
1986	1,456,625.2	48,220.6	398,148.0	1,261,032.6	1,707,401.2	3,164,026.4	0.46	0.54
1987	1,581,422.6	58,971.5	400,922.0	1,370,448.0	1,830,341.5	3,411,764.1	0.46	0.54
1988	1,651,682.7	71,699.6	425,680.0	1,415,654.0	1,913,033.6	3,564,716.3	0.46	0.54
1989	1,881,791.0	83,292.6	437,120.0	1,563,717.8	2,084,130.4	3,965,921.4	0.47	0.53
1990	1,819,480.6	75,350.8	343,982.0	1,418,751.6	1,838,084.4	3,657,565.0	0.50	0.50

Source: Florida Keys Aqueduct Authority, 1990

Table 8.7
Key West Water Sold

Year	Residential (Gallons)	Non-Residential (Gallons)
1986	412,043,029	411,510,591
1987	433,359,200	434,727,700
1988	445,382,800	446,658,400
1989	486,673,000	483,149,100
1990	481,084,100	453,311,200

Note: The Key West figures include all of Stock Island and Key Haven.

Source: Florida Keys Aqueduct Authority, 1991

Table 8.8
Unincorporated County Water Sold

Year	Residential (Gallons)	Non-Residential (Gallons)
1986	1,044,582,171	849,522,009
1987	1,148,063,400	935,720,300
1988	1,206,299,900	968,995,600
1989	1,395,118,000	1,080,568,700
1990	1,338,396,500	965,440,400

Note: This table excludes the City of Key West, as well as Key Haven and the unincorporated portion of Stock Island (Table 8.7). It also excludes Navy and Government since they are not predicted to grow in relation to the County.

Source: Florida Keys Aqueduct Authority, 1991

Table 8.9
Raw Water Produced

Year	Annual Pumpage	Sold/Pumped
1986	4,461,500,000	0.6817
1987	4,794,600,000	0.7116
1988	4,819,800,000	0.7396
1989	4,935,900,000	0.8035
1990	4,404,100,000	0.8305

Note: The last column was calculated by dividing the total water sold by the total water pumped for the entire county to obtain the amount of water that is accounted for.

Source: Florida Keys Aqueduct Authority, 1991

Table 8.10
Residential Water Consumption (1986-1990)

Year	Demand (Gallons)	Permanent	Seasonal	Total	LOS (gpcd)
1986	1,532,360,206	45,763	17,620	63,383	66
1987	1,613,389,618	47,256	17,978	65,234	68
1988	1,631,020,190	48,797	18,344	67,141	67
1989	1,736,333,689	50,389	18,717	69,106	69
1990	1,611,572,734	52,032	19,103	71,135	62

Average = 66.5 gpcd

Note: Seasonal population is the average daily seasonal population living in residences on an annual basis. Added to permanent population yields the total population classified as residential by FKAA.

Source: Florida Keys Aqueduct Authority, 1991

Table 8.11
Non-Residential Water Consumption (1986-1990)

Year	Demand (Gallons)	Area (Square Feet)	LOS (gpd/sf)
1986	1,246,214,762	9,678,713	0.35
1987	1,314,980,878	10,056,651	0.36
1988	1,310,164,568	10,263,916	0.35
1989	1,344,852,434	10,532,049	0.35
1990	1,162,493,644	10,770,457	0.30

Average = 0.35 gpd/sf

Source: Florida Keys Aqueduct Authority, 1991

8.9.3 Potable Water Level of Service Standards

Table 8.12
Potable Water Level of Service Standards

Residential LOS	66.5 gallons/capita/day
Non-Residential LOS	0.35 gallons/square foot/day

Note: Equivalent Residential Unit: 149 gallons per day (2.24 average persons per household X 66.5 gallons/capita/day)

Source: Keith and Schnars, P.A., 1991

SFWMD has suggested that an overall level of service be included for their regulation since it is a requirement of the Consumptive Use Permit application. This LOS is simply the total demand divided by the total population. The total functional population includes permanent plus seasonal population which is defined as the average daily population. The average overall LOS over the past five years is 100 gpd/capita (see Table 8.13).

Table 8.13
Overall LOS - Unincorporated County

Year	Total Demand (Gallons/Year)	Total Population	GPCD
1986	2,778,574,968	75,239	101
1987	2,928,370,496	77,332	104
1988	2,941,184,758	79,484	101
1989	3,081,186,123	81,701	103
1990	2,774,066,378	83,981	90

Source: Florida Keys Aqueduct Authority, Keith and Schnars, P.A., 1991

Due to Monroe County's current low LOS, a goal consumption will not be based on future water conservation by the residents of Monroe County. The goal water consumption is based on FKAA obtaining its goal unaccounted for water (UAW) of 13% by the year 2005 as listed in FKAA's Water Conservation Plan currently under review by SFWMD. The goal consumptions for residential, non-residential and overall use are calculated by applying the goal of 13% UAW to the past five years of demand as shown in Table 8.13. The goal water consumption is presented in Table 8.14.

Table 8.14
Goal Potable Water Consumption

Residential	57 Gallons/capita/day
Non-residential	.29 Gallons/square foot/day
Overall	86 Gallons/capita/day

Source: Keith and Schnars, P.A., 1991

8.10 Present and Projected Future Ability to Meet Level of Service Standards

Through June 14, 1995, the annual SFWMD Consumptive Use Permit allocation of 5.56 billion gallons (15.24 gpd) for the incorporated and unincorporated County compares with a current (1990) consumption of 4.404 billion gallons for the year, producing a reserve allocation for the year of 1.156 billion gallons. At the identified level of service standards above, this potable water supply is sufficient to serve existing land uses plus an additional magnitude of development of some 21,256 equivalent residential units (ERU's). After subtracting the amount of residential and commercial development permitted since April 1, 1990 (2,087 residential units and 392,545 s.f. on non-residential development), sufficient potable water capacity remains to serve some 18,258 equivalent residential units (see Table 8.15). Thus, potable water supply does not appear to be a significant carrying capacity constraint on future development in Monroe County, assuming a constant supply based on the present consumptive use permit.

Table 8.15
Consumptive Use Permit Capacity

C.U.P. Supply	Current Consumption (1990)	Capacity Available	ERU's Remaining
5.56 BGY	4.404 BGY	1.156 BGY	21,256
Committed Development:			
Non-Residential		(.050)	922
Residential		(.113)	2,087
Future Uncommitted Capacity		.993	18,258

Note: Equivalent Residential Unit: 149 gallons per day (2.24 average persons per household x 66.5 gallons/capita/day).

Source: Keith and Schnars, P.A., 1991, Revised 9/21/92.

8.10.1 Alternative Water Supplies

The alternatives for persons living in the Keys who do not obtain water from FKAA are cisterns, home desalination systems, and bottled water for potable use with a supplemental well used for toilets and showers.

The groundwater in the Keys is characteristically high in hydrogen sulfide which is very corrosive to fixtures if used untreated. For this reason, home reverse osmosis plants are useful in the Keys. DER permits these plants, but FKAA estimates that only a handful are presently in use in the Keys. Monroe County has recently undertaken a plan to inventory all wells and cisterns so that the extent of these forms of alternative water supply use will be known. No new potable water wells have been permitted since February of 1986.

The best possibility for augmenting water availability to the Keys is through increased use of desalinated Floridian Aquifer water. Although it is possible to desalinate water from the shallower Biscayne Aquifer, there is not sufficient freshwater in this aquifer to support significant withdrawals. After a short time, water quality in the aquifer would be identical to the surrounding seawater. With careful management, withdrawals from the Floridian Aquifer System could be optimized to prevent water quality degradation and still provide significant quantities of water. Where chloride concentrations are not too great, desalination of Floridan Aquifer water could be economically feasible, and even competitive with importing water via the Florida Keys Aqueduct.

Wastewater reclamation in Monroe County could play a substantial role in the water supply inventory. There are 193 existing wastewater treatment facilities in unincorporated Monroe County of which one has a FDER rated capacity of 0.50 mgd or greater. This facility is the Key West Wastewater Treatment Plant on Fleming Key and has a rated capacity of 7.20 mgd utilizing a surface water discharge for effluent disposal. Surface water discharge disposal results in a net loss/transfer from the water supply inventory. The facility could potentially make reclaimed water available for public access reuse.

8.10.2 Key Carrying Capacity Limitations, Facilities Inadequacies and Policy Constraints

Limiting condition number 25 of the active Consumptive Use Permit indicates that the allocation contained in SFWMD Water Use Permit No. 13-00005-W is "based on the population projections contained in the Monroe County Comprehensive Plan which is pending adoption in late 1990 by the Monroe County Board of County Commissioners pursuant to Chapter 163 F.S. This permit may be subject to modification if the population projections within the plan is revised or modified." The SFWMD has indicated that upon adoption of the Comprehensive Plan, the Consumptive Use Permit will be modified to reflect any changes between the population projections utilized in the permit and the population projections contained in the Comprehensive Plan.

8.10.3 Projected Demand

The future potable water demand was calculated for the current year using the established LOS of 66.5 gallons per capita per day for residential and .35 gallons per day per square foot for non-residential. The ten year planning period (1992-2002) demand was calculated using the projected water demand rate accounting for the FKAA leak detection program which has a goal of 13% unaccounted for water. Please refer to Section 2.4 of the Future Land Use Element for a description of the Future Land Use Concept and the Permit Allocation System. The LOS for the first planning period (1997) is the average of the current LOS and the goal water demand assuming FKAA will reach half of it's unaccounted for water goal by 1997. As shown in Tables 8.16, 8.17, and 8.18, actual water demand will decrease through the planning periods due to the leak detection program and the relatively small increases in

population. Nonresidential square footages were assumed to increase proportionally to the increases in residential building permits (255/year). The government uses were assumed not to increase; therefore, they will not generate additional demands and remain constant. Raw data was not available to determine actual potable water demand for governmental uses for only the unincorporated county. The percentage of government demand for the entire county exclusive of the Navy was assumed to remain constant for the unincorporated portion (2.1 percent) to obtain the total potable water demand for the unincorporated county.

Table 8.16
Projected Residential Potable Water Demand (Unincorporated County)

POPULATION				LOS GAL/CAP/DAY	PROJECTED POTABLE WATER DEMAND (MGD)
YEAR	PERM.	SEAS.	TOTAL		
1992	53,404	19,293	72,697	66.5	4.83
1997	57,882	19,882	77,438	61.8	4.78
2002	59,653	20,181	79,834	57.0	4.55
2010	59,653	20,181	79,834	57.0	4.55

Note: Seasonal population refers to the number of average daily seasonal population living in residenceson a yearly basis.

Source: Keith and Schnars, P.A., 1991, revised 9/21/92.

Table 8.17
Projected Non-Residential Potable Water Demand (Unincorporated County)

YEAR	BLDG AREA (sf)	LOS (gpd/sf)	DEMAND (MGD)
1992	10,890,500	0.35	3.81
1997	11,190,500	0.32	3.58
2002	11,490,500	0.29	3.33
2010	11,490,500	0.29	3.33

Source: Keith and Schnars, P.A., 1991, revised 9/21/92.

Table 8.18
Total Potable Water Demand (Unincorporated County)

YEAR	(MGD) SUBTOTAL	(MGD) GOV'T (1)	(MGD) TOTAL DEMAND
1992	8.65	0.19	8.83
1997	8.36	0.18	8.54
2002	7.88	0.17	8.05
2010	7.88	0.17	8.05

(1) Using a government demand of 2.1% of the total demand

Source: Keith and Schnars, P.A., 1991, revised 9/21/92.

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